EYE ON THE SKY

National Weather Service
Louisville, Kentucky

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A Newsletter for Emergency Managers, Core Storm Spotters, Media and Public Officials in Central Kentucky and South-Central Indiana

Comments and suggestions are always welcome. Your feedback is very important to us!

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"Turn Around, Don't Drown!"

by Mike Callahan, Service Hydrologist

What severe weather-related event kills the most people in this area on average every year? If you guessed lightning, you are wrong; it's flooding. More Kentuckians and Hoosiers lose their lives in floods than in tornadoes or severe thunderstorms. Tragically, most of these deaths are avoidable and the result of bad decisions. Most involve a vehicle and an overflowing stream. Unfortunately, this sad tale was repeated three times with flooding that occurred on the night of March 5, when three Kentuckians drowned.

The first victim hydroplaned in her car and skidded off the road and into a flooded stream. She was swept away as she tried to leave the car. The second was the small son of a man who drove his pickup truck into a flooded road. The father lost the grip of his son as he was fording the flooded stream after abandoning his vehicle. The third was a young man who drove an ATV into a raging stream. He drowned after the ATV capsized.

STARTING WITH THIS EDITION OF "EYE ON THE SKY," ONLY TWO ISSUES WILL BE PRODUCED PER YEAR: THE SPRING AND WINTER ISSUES.

In order to make the public aware of this danger, the National Weather Service has started a new public awareness campaign: "**Turn around, don't drown!**" Over the next few years, you will hear this simple phase many times in an effort to make people realize the dangers of driving near flooded streams, roads and low-water crossings. Remember, if you are driving in heavy rain, slow down and never attempt to cross a flooded road. Be especially careful at night when your vision is limited. If you plunge your vehicle into a flooded stream, at best you will destroy your vehicle, at worse you will lose your life and the lives of your passengers.

INSIDE THIS ISSUE:

The Data Bank

by Don Kirkpatrick, Senior Meteorologist

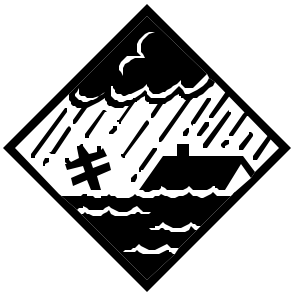
Continuing with this issue of "Eye on the Sky," interesting and little known weather facts relevant to the ongoing or upcoming season are presented to you via "The Data Bank." In this issue, we explore a warm season mirage called a rainbow.

Rainbows have been described as one of the most spectacular light shows observed on earth. They occur as rain falls in one part of the sky and the sun shines in another.

...Continued

Flash Flooding Case Example: Franklin County, KY—August 22, 2003

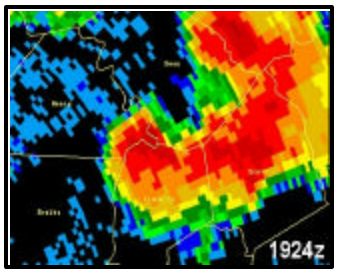
by James Brotherton, Meteorologist

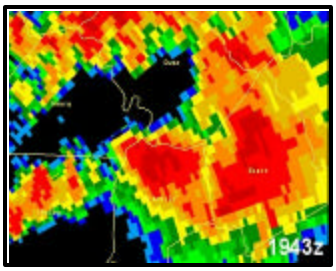


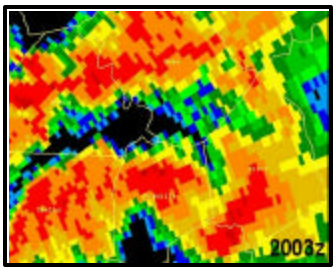
As mentioned in the cover article, flooding is the number one weather-related killer on average in the United States. This is especially true in Kentucky and southern Indiana, where flash flooding can occur practically any time of the year.

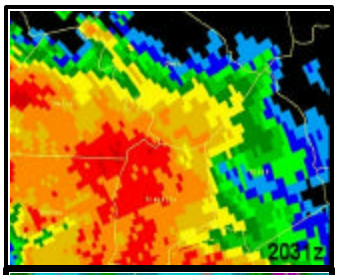
As an example, during the late afternoon of August 22, 2003, localized very heavy rainfall occurred across portions of south-central Indiana and central Kentucky. The atmospheric ingredients responsible for this event included relatively light winds in the lower atmosphere to allow for slow movement of individual cells, along with a moisture-rich environment. In addition, the winds around 3000 ft off the surface of the earth were nearly parallel to the winds around 15,000 ft altitude. This allowed for individual thunderstorm cells to move across the same area (an effect known as "training cells").

Within only a one to two hour timeframe, a portion of northern Franklin County, KY experienced very heavy and persistent rainfall. Numerous training cells caused rainfall amounts of five to six inches. Two deaths were attributed to flash flooding in northern Franklin County, just north of Frankfort.









The first four images above are radar reflectivity images from the NWS Louisville Doppler radar. The four reflectivity images between 1924Z (324 pm edt) and 2031Z (431 pm edt) indicated very heavy training cells (bright red). The image at right, also from the Louisville radar, indicated a localized area of five to six inch rainfall during the same timeframe.

Winter Summary: 2003-2004 Season

by John S. Denman, Meteorologist

Compared to last year's cold and snowy winter, the winter of 2003-2004 was much more tranquil. The past winter will be remembered for an absence of extreme events of either heavy rainfall or snowfall.

Winter Season (Dec-Feb) Snowfall, Inches

Month	*Louisville (NWS office)*	*Lexington*	*Bowling Green*
December	4.3	3.9	0.6
January	6.4	4.7	3.0
February	0.7	Trace	Trace
Seasonal Total Snowfall	11.4	8.6	3.6
Normal Snowfall	14.5	15.7	10.2
Last Year	24.7	18.9	11.5

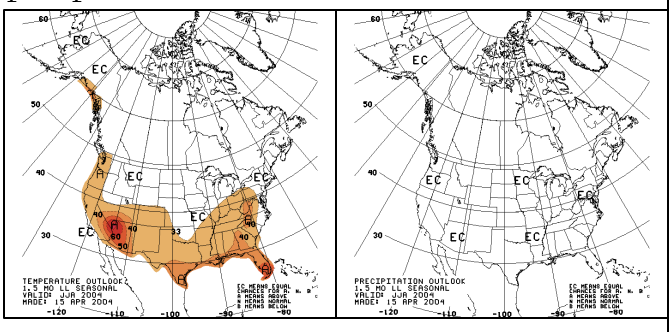
The chart above shows snowfall totals for last December through February for several cities across central Kentucky. None of this winter's snowstorms produced more than around four inches in either central Kentucky or south-central Indiana. Perhaps the most severe winter storm of the season was on January 25, mainly in the form of significant freezing rain and sleet accumulations. Freezing rain amounts of around one-half inch coated roads and power lines across central Kentucky, including the Bluegrass Region. Farther north, one to two inches of mainly sleet fell, along and north of the Ohio River.

Average temperatures for the entire winter season (December through February) were colder than normal at Louisville and Lexington, and near normal at Bowling Green. However, in comparison to last year (2002-2003), temperatures were much milder. The climatological tables on page five show average monthly temperatures and departures from normal for the years 1970 to 2000. The temperature of –5 degrees in Louisville on January 31 was the coldest temperature recorded since February 4, 1996, when it was also –5 degrees.

Check the climatological tables on page five to get your fix of climate data!!

Unlike occasional winters in the past, our region was spared from any excessive rainfall or widespread flooding this past season. In fact, the past winter season precipitation totals were below normal at Lexington and Bowling Green, where seasonal deficits totaled 1.90 and 3.71 inches, respectively. Only at Louisville were precipitation totals near normal.

The latest climate outlook from the Climate Prediction Center for the coming summer season indicates above normal temperatures and near normal precipitation. Go to http://www.cpc.ncep.noaa.gov for the latest climate outlook information.



The latest climate outlook from the NWS' Climate Prediction Center

The Science Corner

by John S. Denman, Meteorologist

Heatburst: A Weather Phenomenon

Imagine yourself out and about late one summer evening. A few thunderstorms may have developed earlier, but they seem to be weakening. Suddenly, gusty winds arrive. The temperature, which had fallen into the 70s, suddenly jumps up into the 90s. You have just witnessed a heatburst, an unusual weather phenomenon that occurs mainly across the high plains and other regions of the western United States.

A heatburst describes a condition where downdrafts from an area of thunderstorms warm temperatures at a certain location dramatically, occasionally as much as 20 degrees in less than 15 minutes. These type of downdrafts do not contain rain...and frequently will usher in very dry air with much lower relative humidities. The thought of outflow from thunderstorms actually warming the air around us seems counterintuitive. All of us have felt the sudden drop in temperature as a thunderstorm gust front moves overhead, soon followed by heavy rain. Several conditions have to be in place to create a heatburst, conditions which are rarely present across the Lower Ohio Valley region.

First, and most important, an area of thunderstorms has to be high-based. This means that the storms form much higher above the ground than is typical of thunderstorms across the eastern United States. Across the high plains and in mountainous areas, the bases of thunderstorms often lie at least 8000 feet above the surface. Rain frequently evaporates even before reaching the ground after falling from the base of these high-based thunderstorms. As rain evaporates underneath the storms, it cools the air around it. This creates downdrafts that draw in relatively warm air adjacent to the descending air. As this warm mid-level air descends next to the area of rain, it is compressed and warms even more as it approaches the surface. As this air nears the surface, it displaces the air right next to the ground, which most likely has cooled considerably during the evening hours.

Secondly, the nocturnal inversion cannot be too deep. This inversion, caused by the cooling of the air right above the ground with the loss of daytime heating, begins in the evening and deepens overnight. During the evening, the nocturnal inversion is usually only a few hundred feet deep. This may increase to over a thousand feet by dawn. The cooler air near the surface is stable and resistant to being displaced. The most likely time of day for a heatburst is during the evening while the nocturnal inversion is still relatively shallow.

I personally experienced a remarkable example of a heatburst earlier in my career in eastern Oregon. After a hot summer day where the temperature exceeded 100 degrees, an area of weakening high-based thunderstorms drifted across a temperature sensor at the local NWS forecast office. Temperatures jumped up from 80 to 92 degrees between 1 and 2 am. High winds accompanied this heatburst with gusts near 40 mph. No rain fell during this storm and only one or two lightning strikes were observed.

Photo © 1980, Fernando Caracena

The image above of a relatively high-based cumulonimbus cloud could be representative of a thunderstorm capable of a heatburst. One of the most dramatic heatbursts ever recorded took place across southwest Oklahoma in the early summer of 1996. During the early morning, a heatburst brought destructive winds of up to 70 mph over a wide area southwest of Oklahoma City. Temperatures all across this region rose 15 to 20 degrees....with the highest reading of 101 recorded just after midnight at a site southwest of Norman, OK. Another heatburst observed in 1996 had wind gusts of 105 mph, with a temperature rise of nearly 25 degrees in only 25 minutes.

Staff Changes and Farewells

NWS Louisville is sad but congratulatory to see two fine members of our staff move on to other career opportunities within the NWS.

First off was Vern Beaver, long-time (20+ years) Hydro-Meteorological Technician (HMT) at NWS Louisville. Vern earned a transfer to sunny Charleston, SC, with the local NWS office there. Along with his primary HMT duties at Charleston, Vern will also manage the cooperative network in their area of responsibility.

Next off will be Tony Sturey, Senior Meteorologist at NWS Louisville, who earned a promotion to Warning Coordination Meteorologist (WCM) at the Caribou, ME office. As WCM in Caribou, Tony will coordinate all matters of severe weather warning systems with local and state agencies in the NWS Caribou area. In addition, Tony will lead Caribou's spotter training, outreach, and educational programs.

We wish Vern and Tony much success and happiness in their respective new roles within the NWS!

Climatological Calendar

Observed Temperatures and Precipitation: Winter 2003-2004

Location	Month	Average Temperature	Departure From Normal	Total Precipitation	Departure From Normal	Highest Temp (Date)	Lowest Temp (Date)
Louisville (NWS)	Dec	37.0	-0.6	3.80	0.11	63 (28th)	18 (20th)
	Jan	30.8	-2.2	4.74	1.46	67 (4th)	-5 (31st)
	Feb	36.4	-1.2	1.81	-1.44	65 (29th)	12 (1st)
Lexington	Dec	35.5	-0.8	3.93	-0.10	63 (28th)	14 (20th)
	Jan	30.3	-1.7	3.32	-0.02	68 (4th)	-6 (31st)
	Feb	36.0	-0.4	1.49	-1.78	65 (29th)	14 (1st)
Bowling Green	Dec	38.3	0.0	3.95	-1.11	63 (28th)	17 (20th, 26th)
	Jan	34.7	0.5	2.96	-1.19	71 (3rd, 4th)	6 (31st)
	Feb	38.1	-0.5	2.74	-1.41	67 (29th)	17 (1st)

Normal High/Low Temperatures

Location	May 1	Jun 1	Jul 1	Aug 1
Louisville (NWS)	71/51	80/61	86/69	87/70
Lexington	70/49	79/59	85/65	86/67
Bowling Green	73/50	82/60	88/67	89/68

Record Monthly High/Low Temperatures

Location	May	Jun	Jul	Aug
Louisville (NWS)	98 (1911) 31 (1963/1966)	103 (1944) 42 (1966)	107 (1901/1930/1936) 49 (1947)	105 (1881/1918) 45 (1946)
Lexington	96 (1941) 26 (1966)	104 (1936) 39 (1966)	108 (1936) 47 (1972)	105 (1936) 42 (1965)
Bowling Green	100 (1911) 28 (1888)	108 (1936) 38 (1888)	113 (1930) 46 (1947)	110 (1881/1930) 42 (1946)

The Data Bank...continued from page 2...

To observe a rainbow is to look at sunlight that has entered falling drops and, in effect, been redirected back toward our eyes. During the summer, rainbows seen after a thunderstorm were portrayed by some Indian tribes as a giant serpent that would occasionally rub its back on the icy sky and hurl pieces of hail to the ground.

A rainbow is seen with our backs to the sun, facing the falling rain. As sunlight enters a raindrop, it slows and bends resulting in refracting violet and red light. Most of the light passes through the drop and is not seen by us; however, light striking the back of the raindrop at a certain angle is internally reflected toward our eyes. Bending light rays from a myriad of raindrops disperse into a spectrum of colors from red to violet reflecting and refracting light at slightly different angles to produce the brilliant colors of a rainbow. Usually, a secondary, much fainter rainbow, with its colors reversed, can be seen above the primary bow. The lesser rainbow is caused when sunlight emerges from a drop after going through two internal reflections with each reflection weakening the light intensity and making the bow dimmer. The color reversal is due to the way light emerges from each drop after going through the reflections.

The weather rhyme: "*Rainbow in the morning, sailors take warning*"

"*Rainbow at night, sailors delight*"

provides a clue to the upcoming weather. In the mid latitudes of the northern hemisphere, clouds tend to move from west to east. The detection of a morning rainbow to the west would likely signify clouds and showers to our west, with the sun in the east. Conversely, an evening bow seen in the eastern sky would signify a clearing trend, as clouds and rain depart to our east with the sun in the western sky. Remember, to see the rainbow, we must face the falling rain with the sun at our backs.

You may have heard the above poetry as the "red sky" in place of "rainbow" (I have heard it that way too). Red light from a rising or setting sun is reflected from the underside of clouds (water droplets). A morning red sky suggests that it is clear to the east and cloudy to the west. A red sky in the evening would imply the contrary.

Astronomical Calendar

Sunrise and Sunset

	Louisville		Lexington		Bowling Green		
Date	**Sunrise**	**Sunset**	**Sunrise**	**Sunset**	**Sunrise**	**Sunset**	Times are given in EDT (Eastern Daylight Time) and CDT (Central Daylight Time), as appropriate.
May 1	547 am edt	734 pm edt	541 am edt	729 pm edt	451 am cdt	635 pm cdt	
Jun 1	521 am edt	801 pm edt	517 am edt	755 pm edt	428 am cdt	700 pm cdt	
Jul 1	524 am edt	810 pm edt	519 am edt	805 pm edt	430 am cdt	709 pm cdt	
Aug 1	546 am edt	752 pm edt	541 am edt	747 pm edt	451 am cdt	652 pm cdt	

Moon Phases

New Moon	First Quarter	Full Moon	Last Quarter
Apr 19	Apr 27	May 4	May 11
May 19	May 27	Jun 3	Jun 9
Jun 17	Jun 25	Jul 2	Jul 9
Jul 17	Jul 25	Jul 31	Aug 7

Summer Solstice (start of summer):

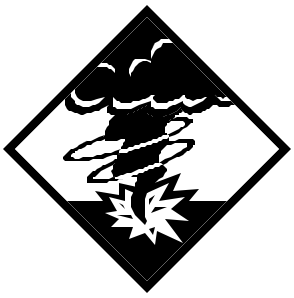
Jun 20 at 857 pm edt (757 pm cdt)

Louisville skyline—courtesy Greater Louisville CVB

Special Report: Remembering the April 3, 1974 Super-Outbreak

by Norm Reitmeyer, Warning Coordination Meteorologist

April 3, 2004 marked the 30th anniversary of the greatest outbreak of tornadoes on record in the United States. Some 28 tornadoes impacted Kentucky, the worst storm disaster in the state's history. These tornadoes killed 77 people, injured 1377, and caused over $100 million in damage. Losses were sustained by 6,625 families. The tornadoes affected 39 counties.



The first storm was the most severe. It touched down five miles southwest of Hardinsburg at 340 PM cdt and 30 minutes later slammed into Brandenburg. This tornado, the only F5 tornado on record in Kentucky, then tore through Brandenburg, killing 31, including a number of children apparently playing outside after school.

Within an hour of the Brandenburg death and destruction, five other tornadoes touched down at locations ranging from Louisville and Boone County in the north to Simpson County near the Tennessee border. The pattern of rapid development farther south and east, with individual tornadoes moving rapidly northeast, continued into the evening.

The Louisville tornado touched down at 437 PM cdt, a quarter mile north of Standiford Field. It was witnessed by employees at the National Weather Service Forecast Office. This storm was on or close to the ground as it traveled through 10 miles of residential property. In the eastern three or four miles of the metropolitan area, the maximum F4 intensity was reached. Three deaths were attributed directly to the tornado, with three others reported killed by heart attacks. A total of 225 injuries were reported in Louisville and Jefferson County.

Pulaski County, in south-central Kentucky, was struck by three separate tornadoes during the evening. The first touched down near Mt. Victory at 755 PM cdt, and moved into Rockcastle County, killing six and injuring 30 in Pulaski County. One death and 10 injuries were reported in Rockcastle County. A second tornado moved into southern Pulaski County shortly after 9 pm after killing two and injuring 16 in eastern Wayne County. The third Pulaski County tornado was apparently Kentucky's final of the outbreak. It occurred between 1130 pm and midnight, as the parent storm moved from Piney Grove Church near the Russell County line through Nancy and Bobtown to Level Green in Rockcastle County.

This dramatic photo was taken near New Salisbury, IN, by (ret.) Indiana State Trooper Donald Mayden. The excellent visibility of the storm features (wall cloud and funnel cloud) is unusual for our region. Often, these features are obscured by heavy rainfall due to high moisture levels in the local environment. The visibility phenomenon was a definitive theme during the Super-Outbreak across southern Indiana and central Kentucky.

Killer storms also were reported in Boyle, Clinton, Franklin, Hardin, Madison, Nelson, Simpson, and Warren Counties.

All told, the Super-Outbreak of 1974 spawned 148 observed tornadoes across 13 states in the eastern United States, causing a horrendous 330 fatalities and 5484 injuries.